

Emergent diabetic ketoacidosis (DKA) management in adults: Rapid overview

Clinical features
DKA usually evolves rapidly over a 24-hour period.
Common, early signs of ketoacidosis include nausea, vomiting, abdominal pain, and hyperventilation. The earliest symptoms of marked hyperglycemia are polyuria, polydipsia, and weight loss.
As hyperglycemia worsens, neurologic symptoms appear and may progress to include lethargy, focal deficits, obtundation, seizure, and coma.
Common causes of DKA include: infection; noncompliance, inappropriate adjustment, or cessation of insulin; new-onset diabetes mellitus; and myocardial ischemia.
Evaluation and laboratory findings
Assess vital signs, cardiorespiratory status, and mental status.
Assess volume status: vital signs, skin turgor, mucosa, urine output.
Obtain the following studies: serum glucose, urinalysis and urine ketones, serum electrolytes, BUN and creatinine, plasma osmolality, mixed venous blood gas, electrocardiogram; add serum ketones if urine ketones present.
DKA is characterized by hyperglycemia, an elevated anion gap* metabolic acidosis, and ketonemia. Dehydration and potassium deficits are often severe.
Serum glucose is usually greater than 250 mg/dL (13.9 mmol/L) and less than 800 mg/dL (44.4 mmol/L). In certain instances (eg, insulin given prior to emergency department arrival), the glucose may be only mildly elevated.
Additional testing is obtained based on clinical circumstances and may include: blood or urine cultures, lipase, chest x-ray.
Management
Stabilize the patient's airway, breathing, and circulation.
Obtain large bore IV (≥ 16 gauge) access; monitor using a cardiac monitor, capnography, and pulse oximetry.
Monitor serum glucose hourly, and basic electrolytes and venous pH or bicarbonate every two to four hours until the patient is stable.
Determine and treat any underlying cause of DKA (eg, pneumonia or urinary infection, myocardial ischemia).
Replete ECF volume and free water deficits:
<ul style="list-style-type: none"> Give several liters of IV isotonic (0.9%) saline as rapidly as possible to patients with signs of shock. Give IV isotonic (0.9%) saline at 15 to 20 mL/kg per hour (ie, 1 to 1.5 L per hour for an average-sized adult), in the absence of cardiac compromise, for the first few hours to hypovolemic patients without shock. After intravascular volume is restored, give one-half isotonic (0.45%) saline at 4 to 14 mL/kg per hour if the corrected serum Na^+ [¶] is normal or elevated; isotonic saline is continued if the corrected serum Na^+ [¶] is reduced. Add dextrose to the saline solution when the serum glucose reaches ~ 200 mg/dL (11.1 mmol/L).
Replete potassium (K+) deficits:
<ul style="list-style-type: none"> Regardless of the initial measured serum K+, patients with DKA have a large total body K+ deficit. If initial serum K+ is below 3.3 mEq/L, hold insulin and give potassium chloride 20 to 40 mEq/hour IV until K+ concentration is above 3.3 mEq/L; rarely, additional potassium supplementation may be necessary to avoid life-threatening muscle weakness and cardiac arrhythmias. If initial serum K+ is between 3.3 and 5.3 mEq/L, give potassium chloride 20 to 30 mEq per liter IV fluid; maintain serum K+ between 4 to 5 mEq/L. If initial serum K+ is above 5.3 mEq/L, do not give potassium; check serum K+ every 2 hours; delay administration of potassium chloride until serum K+ has fallen to 5 to 5.2 mEq/L.
Give insulin:
<ul style="list-style-type: none"> Do not give insulin if initial serum K+ is below 3.3 mEq/L; replete K+ and fluid deficit first. Give all patients without a serum K+ below 3.3 mEq/L regular insulin. Either of two regimens can be used: 0.1 units/kg IV bolus, then start a continuous IV infusion 0.1 units/kg per hour; OR do not give bolus and start a continuous IV infusion at a rate of 0.14 units/kg per hour. If serum glucose does not fall by at least 50 to 70 mg/dL (2.8 to 3.9 mmol/L) in the first hour, double the rate of insulin infusion. When the serum glucose reaches 200 mg/dL (11.1 mmol/L), it may be possible to decrease the infusion rate to 0.02 to 0.05 units/kg per hour. Continue insulin infusion until ketoacidosis is resolved, serum glucose is below 200 mg/dL (11.1 mmol/L), and subcutaneous insulin is begun.
Give sodium bicarbonate to patients with pH below 6.90:
<ul style="list-style-type: none"> If the arterial pH is below 6.90, give 100 mEq of sodium bicarbonate plus 20 mEq of potassium chloride in 400 mL sterile water over two hours; may be repeated if venous pH remains below 7.00.

DKA: diabetic ketoacidosis; BUN: blood urea nitrogen; IV: intravenous; ECF: extracellular fluid; Na: sodium; K: potassium.

* Patients with DKA usually present with a serum anion gap greater than 20 mEq/L (normal range approximately 3 to 10 mEq/L). However, the increase in anion gap is variable, being determined by several factors: the rate and duration of ketoacid production, the rate of metabolism of the ketoacids and their loss in the urine, and the volume of distribution of the ketoacid anions.

¶ Serum Na^+ should be corrected for hyperglycemia; for each 100 mg/dL serum glucose exceeds 100 mg/dL (5.5 mmol/L), add 2 mEq to plasma Na^+ for correction of Na^+ value for hyperglycemia. A calculator to determine serum Na^+ corrected for hyperglycemia is available separately in UpToDate.